RESOLUTION NO. 2019-12

A RESOLUTION OF THE VILLAGE COUNCIL OF THE VILLAGE OF KEY BISCAYNE, FLORIDA, AUTHORIZING THE VILLAGE MANAGER TO ENTER INTO AGREEMENTS WITH THE UNIVERSITY OF MIAMI FOR ENVIRONMENTAL STUDIES RELATED TO POTENTIAL SOURCES OF ENTEROCOCCI ON VILLAGE BEACHES AND THE EFFECT OF NOISE POLLUTION ON MARINE LIFE; PROVIDING FOR IMPLEMENTATION; AND PROVIDING FOR AN EFFECTIVE DATE.

WHEREAS, the Village of Key Biscayne ("Village") desires to conduct studies to determine the potential sources of enterococci on the Village's beaches ("Enterococci Study") and to determine the effect of noise pollution on marine life ("Noise Study"), collectively, the "Studies"; and

WHEREAS, the Village Council desires to engage the University of Miami ("Consultant") to perform the Studies; and

WHEREAS, the Consultant has provided proposals to conduct the Studies, attached hereto as Exhibits "A" and "B" (the "Proposals"); and

WHEREAS, the Village Council desires to authorize the Village Manager to enter into agreements with the Consultant consistent with the Proposals; and

WHEREAS, the Village Council finds that this Resolution is in the best interest and welfare of the residents of the Village.

NOW, THEREFORE, BE IT RESOLVED BY THE VILLAGE COUNCIL OF THE VILLAGE OF KEY BISCAYNE, FLORIDA, AS FOLLOWS:

Section 1. Recitals. That each of the above-stated recitals are hereby adopted, confirmed, and incorporated herein.

Section 2. Authorization. That the Village Manager is hereby authorized to negotiate and enter into agreements with the Consultant that are consistent with the Proposals in

an amount not to exceed $86,000, subject to approval by the Village Attorney as to form, content, and legal sufficiency.

Section 3. Implementation. That the Village Manager is hereby authorized to take any and all actions necessary to implement the purposes of this Resolution.

Section 4. Effective Date. That this Resolution shall be effective immediately upon adoption hereof.

PASSED and ADOPTED this 26th day of February, 2019.

ATTEST:

MICHAEL W. DAVEY, MAYOR

JENNIFER MEDINA, CMC
VILLAGE CLERK

APPROVED AS TO FORM AND LEGAL SUFFICIENCY:

VILLAGE ATTORNEY

EXHIBIT "A"

Evaluating Potential Sources of Enterococci to Key Biscayne Beach

(DRAFT)

Submitted by

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Evaluating Potential Sources of Enterococci to Key Biscayne Beach

Introduction

The beach at the Village of Key Biscayne has experienced elevated levels of the fecal indicator bacteria, enterococci, which is used to set beach advisories. Beach advisories are based upon sample collection and analysis through the Miami-Dade Department of Health. Samples are collected once a week and analyzed using a method called membrane filtration (MF). Through MF the water sample that is collected is filtered through a 0.45 micron filter, placed on growth specific media (mEI agar), incubated for 24 hours, and colonies are then counted. The units of measure are thus colony forming units per 100 milliliters (CFU/100ml). Beach advisories are issued if two consecutive samples exceed 70 CFU/100ml for enterococci. These advisories are reported centrally to the Florida Department of Health and are reported on-line through the Florida Healthy Beaches Program web site.

Another method of analysis is known as chromogenic substrate (IDEXX). Chromogenic substrate is based upon a color change due to the presence of the indicator bacteria within a series of wells. The number of positive wells are counted and the bacteria levels are then determined statistically. Because of the need for statistics to estimate the bacteria numbers, the units of measure are given in most probable number (MPN/100ml). Groups outside Miami-Dade Department of Health, such as Surfrider and WaterKeeper, use the chromogenic substrate method. Generally, in practice, the MF and chromogenic substrate methods are considered to be equivalent methods for monitoring purposes.

We recommend the MF method as the "main" method of sample analysis because it is the method used by Miami-Dade Department of Health. This will allow results to remain consistent with the approach used by the organization that issues the beach advisories.

Historical Records of Enterococci

Beaches at all Florida coastal counties have been monitored for enterococci by Miami-Dade Department of Health since the year 2000. The enterococci concentrations are reported on a weekly basis and these values can be averaged for a given year or over a particular season. In terms of yearly averages (Figure 1), the enterococci concentrations appear to have increased at Key Biscayne Beach from 2016 through 2018 in comparison to concentrations measured in 2007 to 2015. Overall the average enterococci level was 12.1 CFU/100ml for the entire period of record (2000 to 2018). For 2007 to 2015, the average was 7.8 CFU/100ml suggesting an improvement in water quality during this time. However, during the last three years, the average concentrations have increased to 22.7 CFU/100ml (for 2016-2018). The differences in enterococci concentrations between these two periods are statistically significant as computed using t-tests. So in summary, enterococci levels have increased at Key Biscayne Beach during the last three years in comparison to the levels measured during the prior 9 years.

In terms of seasonal averages, the highest levels of enterococci are measured during the fall (20 CFU/100ml on average), followed by the summer (13 CFU/100ml), and then the spring and winter seasons (10 and 9 CFU/100ml, respectively) (Figure 2). The fall is known for tides higher than usual (known as king tides) and this may be a reason for the higher levels during the fall. The medium-high levels during the summer may be due to higher intensity use of the bathing waters by people and the generally higher amounts of seaweed. Interestingly the winter season is low which is when migratory birds may be more readily observed at the beach.

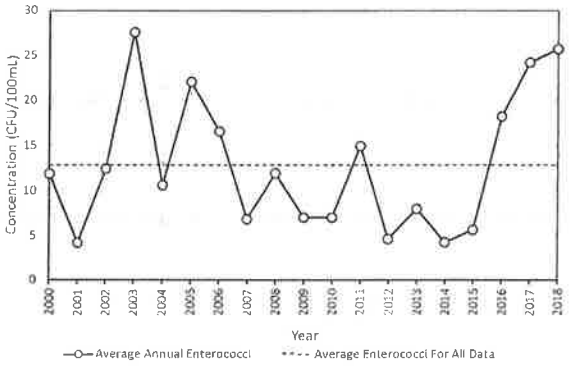

Figure 1: Average yearly enterococci concentrations at Key Biscayne Beach from 2000 to 2018

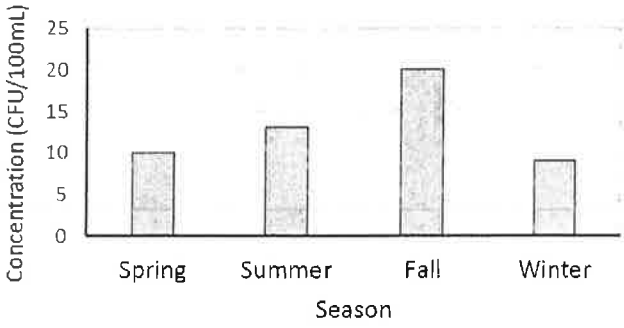

Figure 2: Average seasonal enterococci concentrations at Key Biscayne Beach for the 2000 to 2018 period of record

Objectives and Approach

The objectives of this project are to evaluate potential sources of enterococci at Key Biscayne Beach. The beach was visited on October 11, 2018. This visit included a tour of the surrounding areas. During discussions with Key Biscayne staff the potential sources were listed as:

- Sewage from the Central District Wastewater Treatment Plant
- Sources from leaking sewers or septic tanks plus diffuse local sources including bather shedding and from animals, in particular from birds and dogs

During the visit on October 11, the area had been recently groomed by incorporating seaweed into the sand. This resulted in darker sand (See photo A) due to the seaweed integration along the intertidal zone at the beach. There were discussions about whether this integration promoted the retention of bacteria. So the third contributor towards elevated bacteria levels to be investigated is:

- Seaweed. It is believed that seaweed and its integration into the sand may contribute towards the retention of bacteria.

Photo A: Integration of seaweed into intertidal sands at Key Biscayne Beach

Birds feed near seaweed encouraging the accumulation of bird feces. Also the seaweed retains moisture and nutrients which may help bacteria to persist.

Three phases of research are therefore proposed to evaluate each of these suspected sources. These phases are as follows.

Phase I: Evaluate Correlations with Sewage from the Central District Wastewater Treatment Plant

The Central District Wastewater Treatment Plant (CDWWTP) discharges 143 million gallons of treated wastewater effluent through a diffuser located 3.6 miles offshore at a depth of about 100 feet of water. Although the treatment and the diffuser system has been designed to limit the impacts of the treated sewage on nearby coastal waters, this potential source should be evaluated given its close proximity to Key Biscayne Beach (Figure 3), large volume of effluent, and the variability in the effluent characteristics. Although the CDWWTP operates within standards, it is possible that variations in effluent quality and/or elevated volumes of discharge from the CDWWTP could be the associated with enterococci levels at Key Biscayne Beach.

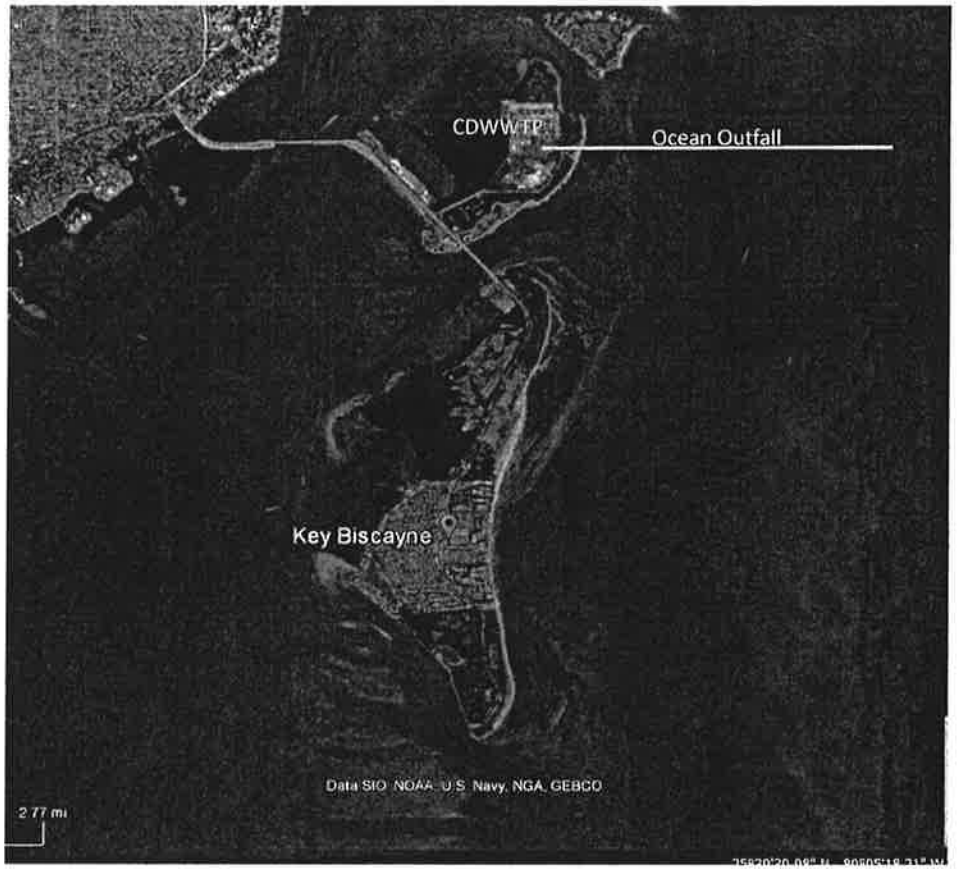

Figure 3: Location of CDWWTP and its ocean outfall relative to Key Biscayne

To evaluate this, we will focus on obtaining records of discharge and effluent quality from the CDWWTP. With the assistance of Anita Nash of the FDEP, we have obtained a contact within the Southeast District of the FDEP who would be able to pull the data from the FDEP database. We already have the FHBP records of enterococci for Key Biscayne Beach for 2000 through 2018. Our plan is to evaluate associations between the enterococci data and the effluent volume and quality. We plan to prepare time series plots, and regression plots to evaluate possible patterns, trends and correlations. If associations are found with CDWWTP quality or volume, then some evidence would be available to identify the CDWWTP as a possible contributor which should be explored further.

Phase II: Evaluate Human and Animal Sources

With respect to public health, human sources of enterococci are considered to be the most problematic, primarily because humans share a lot of diseases with other humans. Animal sources are also of concern, but the risks are lower due to the fewer number of diseases shared among humans and dogs or birds.

Human sources of enterococci can come from sewage. Untreated sewage is of primary concern due to the especially high levels of enterococci (and other disease causing organisms). There are sewer pipes within the Village of Key Biscayne which carry untreated sewage to the treatment plants. There is a possibility that these pipes can be leaking. There are also septic tanks within the Village and malfunctioning septic tanks under certain hydraulic conditions can also potentially serve as a source. In addition to these sources, enterococci can also come off of the skin of human bathers. When the beach is heavily used it is possible for this source to be significant to the point of causing an enterococci esceedance. In summary there are several potential human sources of enterococci so it is worth determining whether human sourced enterococci is impacting the beaches.

Similarly, animals that frequent the beach have also been shown to be significant sources. Dog feces in particular are known to harbor large numbers of enterococci. Bird feces also harbor enterococci but to a lesser extent than dog feces.

Two general approaches will be taken to evaluate the sources of enterococci. These approaches include:

- Microbial source tracking (MST). There are specific biological markers for humans versus animal sources. In speaking to collaborators on this topic, they recommend two human markers (HF183 Bacteroidales, and HumBac), the *Catellicoccus* gull marker for seabirds, and the DogBac Bacteroidales marker for dogs. They also recommend inclusion of the general enterococci marker to provide a basis for comparison between the MF method used for beach monitoring and the molecular-based methods which are based upon a process called PCR.
- Chemical markers. Four chemical markers have been recommended by Anita Nash of the FDEP to trace untreated sewage. These include: acetaminophen, naproxen, ibuprofen, and hydrocodone. For treated sewage caffeine and sucralose are recommended.

We plan to outsource the analysis of chemical markers. MST will be completed through a collaboration with Dr. Maribeth Gidley who works for U.Miami, but whose lab is located at NOAA-AOML located at Virginia Key (laboratory of Drs. Chris Sinigalliano and Maribeth Gidley). Drs. Gidley and Sinigalliano are experts in the MST analysis and their laboratory is located within a 10 minute drive of Key Biscayne. For the chemical markers, we have heard back from one of the two laboratories contacted. The laboratory that responded (ALS Global in Washington State) indicated that they can analyze for the untreated and treated sewage markers. The cost is provided on the budget page. We plan to integrate the analysis of the MST and chemical markers with the monthly sampling described below. The MST markers will be analyzed monthly as part of the regular monthly sampling program. The results from MF and MST measurements can be used to trigger the analysis for the chemical markers.

Phase III: Evaluate Seaweed and Other Factors as Contributors to Elevated Bacteria Levels

A transect will be set up to evaluate enterococci at three water locations and at three sand locations on a monthly basis. This transect will align with the location at which Miami-Dade Department of Health collects its weekly sample. The water sample will be collected in ankle deep water, in knee deep water, and in waist deep water. Sand will be collected in the subtidal zone in knee deep water, in the intertidal zone, and in the supratidal zone (just above the high tide line). In addition to 6 enterococci measurements (3 in water and 3 in sand), the following additional measures will be taken:

- General weather conditions as documented by an iPhone App called Navclock which provides air temperature, humidity, and wind speeds.
- Additional weather conditions will be documented by noting whether it is sunny, overcast, or raining. We will also record an estimate of wave height. We will download rainfall records from the closest rainfall monitoring station to document antecedent rainfall conditions. Tidal height at the time of sampling will be obtained from the nearest tide gauge.
- Basic water quality measurements will be taken (salinity, pH, water temperature, and turbidity). Salinity, pH, and water temperature will be collected with a water quality sonde Turbidity will be measured in the lab.
- Human load and animal load observed 100 feet to the left and right of the transect will be recorded.
- Seaweed characteristics will be measured, including the depth and length of the seaweed strand. The estimate age will also be recorded (fresh, semi-dry, very dry). We will also seek the beach grooming records to include this information in our analyses.
- Photo of the site will be taken from the same location to have a time history of what the beach looked like during each sampling period.

These measurements will be collected monthly over a period of one year to assess possible relationships between environmental measures (including measures of seaweed) and enterococci

levels. This information will be useful for the Village to take pro-active efforts to minimize enterococci exceedances at its beach.

Timeline

Project Period February 1, 2019 to July 31, 2020 (18 months)

	2019											2020						
Task	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J
Preparations	X	X	X	X														
Phase I		X	X	X	X	X	X											R
Phase II					X		X		X									R
Phase III			X	X	X	X	X	X	X	X	X	X	X	X				R
Meetings (M)/Reports(R)		M			M			M			M			M			M	R

Budget (This budget has not been officially approved by the University of Miami):

Item	Amount
PhD Student Stipend, Insurance, and Tuition (20% time)	$25,766
Research Scientist (Dr. Gidley for MST, 4% time)	$10,198
Undergraduate Student (300 hours)	$7,525
Supplies	$3,612
Local Travel (mileage to and from beach)	$2,899
Subtotal	$50,000

Note: Budget does not include costs for the Chemical Marker analyses as this will be outsourced to a different laboratory. The U.Miami team will be responsible for sending the samples to the laboratory and for integrating the results into the overall study.

Estimated cost of Chemical Markers:

- $400/sample for untreated sewage markers (acetaminophen, naproxen, ibuprofen, and hydrocodone).
- $400/sample for treated sewage markers (caffeine and sucralose)

Option:

- If there is a desire to also analyze the samples by chromogenic substrate (IDEXX) we can include those samples as long as the supplies are purchased by the Village outside of the contract. We will accommodate the labor costs within the $50K budget already set, but the supplies will need to come from another source.

EXHIBIT "B"

Impacts of noise pollution associated with the ULTRA Music Festival on fish

UM scientists, Drs. Berenshtein, Cartolano, Heuer, McDonald, Paris-Limouzy, and Grosell propose to conduct a series of controlled experiments in combination with field monitoring to quantify the impacts of noise pollution from the 2019 ULTRA Music Festival to take place in Virginia Key in March. The research team is committed to providing an objective report of their findings no later than 40 days after the concert and is committed to producing a peer-reviewed publication reporting the results of the study. Typically, the University of Miami requires that a portion of research grants awarded to scientists are allocated to institutional operating costs. However, in this unique case, the University of Miami has agreed to waive these costs in order to ensure maximal research value of the requested funding for this local issue. In the following, we outline experiments that will be performed prior to, during, and after the event.

I. Controlled experiments

The Gulf toadfish (*Opsanus beta*), a local and benthic species, will be used for these experiments for three primary reasons. First, toadfish play an important ecological role in the local environment as they are a common prey item for sentinel species such as dolphins. Second, toadfish vocalizations contribute to the local marine soundscape and they rely heavily on their hearing for reproduction, social interactions, and predatory avoidance. Third, toadfish have well-characterized responses to stress that our research team has studied extensively. The proposed experiments will utilize the very sensitive stress response of toadfish to determine the impacts of noise from to the music festival by measuring fluctuations in stress hormones (cortisol and ACTH) found in blood.

Toadfish will be placed in holding tanks at the UM Experimental Hatchery immediately adjacent to the Virginia Beach Park weeks prior to the concert in March and blood will be sampled after a sufficient acclimation period to obtain baseline levels of stress hormones. These baseline levels are expected to be low and similar to those of wild fish. An additional set of fish will be held under identical conditions immediately before, during, and after the ULTRA Music Festival, and their blood will be sampled during peak intensity of the festival. Elevated stress hormone levels in samples from these fish will indicate stress in response to the event. Sampling one week after the festival will also allow us to determine if the stress response can recover after three continuous days of noise pollution. For these experiments, sound will be recorded adjacent to, and in the toadfish holding tanks in order to match stress levels to sound intensity.

II. Field monitoring

Underwater sound recording devices (hydrophones) will be also be deployed in two places to obtain before, during, and after soundscapes. First, recordings from Bear Cut directly in front of Virginia Beach Park will quantify and document the magnitude of noise pollution coming from the event. These recordings will be compared to baseline recordings collected before the festival to determine the level of noise pollution that wild fish endured. Additionally, we will compare these recordings to those obtained from toadfish experimental holding tanks to more broadly estimate stress induced in wild fish in Bear Cut during the event. Second, recordings in "Jimbo's Lagoon", located east of Virginia Beach Park and generally void of boat traffic, are intended to capture the natural sounds produced by Gulf toadfish and other marine organisms in this area before, during, and after the event. Studies on Gulf toadfish and other fish species have demonstrated reduced vocalizations in response to noise pollution and our field

monitoring will allow us to determine if the noise associated with ULTRA altered the natural marine soundscapes surrounding Virginia Key.

Sound in water and hearing by fish dictates detailed characterization of sound

The propagation of sound in water differs from that in air. Since air is compressible, land dwelling animals rely on pressure sensing diaphragms, like eardrums, for hearing. In contrast, water is much less compressible and sound results in particle (water) movement in addition to pressure gradients. Consequently, marine organisms both "hear" and "feel" noise in the water and rely on a range of specialized sensory systems to detect fluctuations in acceleration and velocity of their surrounding water to detect sound. Since fish detect mainly particle movement to "hear", particle movement along with pressure gradients will be determined for pre-event and during event periods from both controlled experiments and field monitoring.

III. Budget

Drs McDonald, Paris-Limouzy, and Grosell are tenured professors at RSMAS and will be responsible for project completion and reporting. They offer their time and expertise at no cost to this project. In addition, existing relevant equipment for sound recording, cortisol analyses, as well as blood sampling is available for the present project. The majority of the requested funds will cover salaries for postdoctoral fellows Drs Berenshtein, Cartolano, and Heuer, who will perform the day-to-day observations before, during, and after the event, as well as the extensive sample and data analyses involved with the proposed work. In addition, a modest supply budget and funds for purchase of additional hydrophones and recorders is requested as detailed below.

Item	**Cost**
Salaries (2 months for each postdoctoral fellow)	$31,793
Hydrophones/recorders (4 at $500 ea)	$2,000
Analytical cost of measuring ACTH and cortisol	$ 1238
General lab supplies (needles, syringes, sample tubes, liquid nitrogen, etc)	$ 429
Toadfish holding facilities	$ 300
Experimental fish	$ 240
Total	$ 36,000